

Atmospheric circulation of brown dwarfs

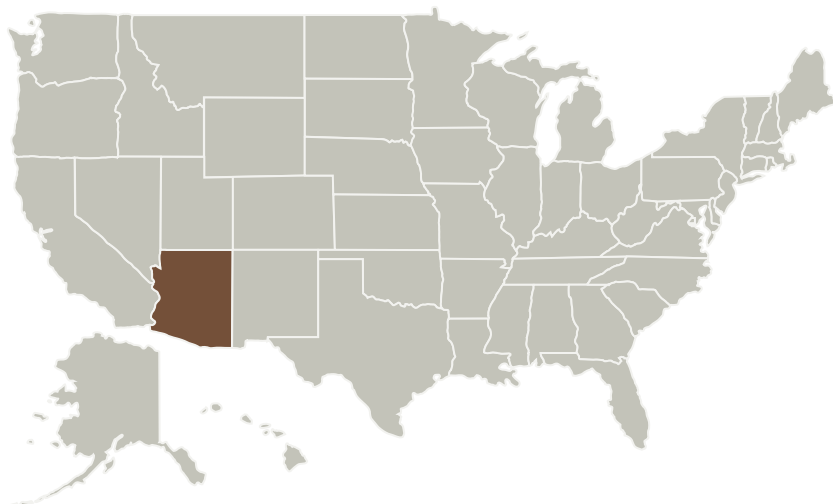
Completed Technology Project (2016 - 2017)



Project Introduction

My work on the proposed project "atmospheric circulation of brown dwarfs" over the past year contains two parts. First is the remaining part of the year-1 project – the effects of latent heating on atmospheres of brown dwarfs. Using numerical simulations and a simple analytical scaling theory, we proposed that the fractional coverage area of storms gets smaller as the spectral type goes through the L/T transition. This provides a mechanism for cloud breaking, which is a hypothesis to explain properties of the L/T transition. This work has been presented in several conferences. We have written up a solid draft about these results, and we expect to submit a paper in March. Second is the development of an updated general circulation model (GCM) for the next phase of my project. The new model includes a band-gray radiative transfer scheme that can treat multiple scattering by cloud particles, a hydrological cycle scheme with simple cloud formation and precipitation, convective adjustment schemes for both dry and moist convection, and finally a parameterization of convective perturbations. Almost all components (except for the moist convection scheme) have been carefully and extensively tested and behave correctly as expected. In the coming year, we will run a series of simulations in a wide range of parameter space using the new model to characterize the global circulation patterns of brown dwarfs. By carefully analyzing the results, we will be able to investigate the brightness variability of brown dwarfs caused by evolution of cloud structures and properties of cloud distributions around the L/T transition of brown dwarfs.

Primary U.S. Work Locations and Key Partners



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Table of Contents

Project Introduction	1
Primary U.S. Work Locations and Key Partners	1
Organizational Responsibility	1
Project Management	1
Technology Areas	2
Target Destination	2

Organizational Responsibility

Responsible Mission Directorate:

Science Mission Directorate (SMD)

Responsible Program:

Astrophysics

Project Management

Program Manager:

Joe Hill-kittle

Continued on following page.

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Organizations Performing Work	Role	Type	Location
University of Arizona	Supporting Organization	Academia Alaska Native and Native Hawaiian Serving Institutions (ANNH)	Tucson, Arizona

Primary U.S. Work Locations

Arizona

Project Management
(cont.)

Principal Investigator:

Adam Showman

Co-Investigators:

Tyler Roberts

Xianyu Tan

Technology Areas

Primary:

- TX11 Software, Modeling, Simulation, and Information Processing
 - └ TX11.2 Modeling
 - └ TX11.2.4 Science Modeling

Target Destination

Outside the Solar System